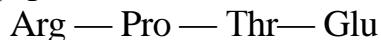


***TASKS FOR THE EXAM IN «BIOCHEMISTRY» FOR FOREING STUDENTS***

**1.** Write the formula of tetrapeptide:



- a) in the peptide single out repetitive groups which form the peptide backbone; also single out variable groups which are represented by aminoacids' radicals;
- b) mark N-terminus и C-terminus;
- c) underline peptide bonds;
- d) write another peptide consisting of the same aminoacids.

**2.** Write the formulas of aminoacids which make HbA and HbS different; compare properties of these aminoacids (polarity, charge).

**3.** Within 25 minutes 10 mg. of lactate dehydrogenase catalyze conversion of pyruvate into lactate in the amount 20 mcM if the temperature is 38,8°C and pH value is 7,8. Calculate specific activity of thi enzyme. Explain why and how will enzyme's activity change, if:

- 1) pH value of incubation mixture is 5,0;
- 2) you dicrease concentration of  $\text{NAD}^+$ .
- 3) you inrease temperature up to 75°C
- 4) you add inhibitor of lactate dehydrogenase into this chemical environment

**4.** There is deletion of 19 nucleotides in a structural gene of a somatic cell.

- A. Is there a shift of a frame which reads genetic information during translation?
- B. Can such mutation be the reason for a hereditary disease? Explain why or why not.

**5.** In an ovum in a descriptive part of a gene which encodes structure of homogenesitic acid oxidase there is a change of the 9th nucleotide which leads to production of a stop codon. Explain:

- A. Which changes in protein structure will take place during the translation of a mutagenic gene?
- B. What will be be phenotypical consequences as a result of this mutation?

**6.** A patient with a bad case of pneumonia is prescribed to take antibacterial drug. Explain the mechanism of bactericidal action of the drug:

- 1) what is the pattern of the process which is inhibited by antibacterial drug
- 2) what are the reasons for disturbance of bacterial protein synthesis in the organism of a patient under the influence of this drug and the reasons for the high selectivity of the drug.

**7.** Define the nature and reasons of the respiration speed change within the experiment with isolated mitochondria when malate is used as an oxidative substrate if:

- A) we add an inhibitor of NADH-dehydrogenase into incubation mixture;
- B) we add succinate together with the inhibitor;
- B) we add cyanide into incubation mixture.

**8.** Toxic effect of cyanides is determined by their selective interaction with  $\text{Fe}^{3+}$  within a heme. Explain why immediate injection of nitrite to blood has a thereapeutic effect in case of cyanides poisoning?

**9.** Calculate the number of moles of ATP which is synthesized due to oxidation of 2 mole of pyruvate. To do this:

A) write an overall equation of oxidative decarboxylation of pyruvic acid, name enzymes and coenzymes of multienzyme complex;

B) use pattern of electron transfer chain and show the hydrogen pathway from pyruvate to oxygen;

B) Calculate oxidative phosphorylation coefficient for the given reaction

**10.** If we add malonic acid (which is a structural analogue of succinate) to the mitochondrial suspension, there will be drastic decrease in oxygen consumption by cells. But if we add citrate, it won't influence oxygen consumption. At the same time, supplement of fumarate stimulates oxygen consumption. Explain these results of the experiment. To do this:

A) Write the equation of the reaction which is inhibited by malonate, name the enzyme;

B) Follow the pathways of conversion of fumarate and citrate according to the citric acid cycle. Explain how does the presence of malonate influence these reactions.

**11.** A 4-month child was admitted to hospital with diarrhea after milk feeding. To diagnose a child special test on tolerance to lactose was used. A patient was given 40 gr. of lactose dissolved in water on an empty stomach. In 20, 40 and 60 minutes concentration of glucose in blood was measured; glucose concentration did not increase. Give possible reasons for the achieved results, explain them. To do this:

a) write the pattern of the reaction which happens with lactose in the intestines, name the enzyme;

b) explain why concentration of glucose in blood does not increase.

**12.** During the experiment in one of the samples which contained solution of sacrose, lactose and starch they added pancreatic juice of a healthy person. In another sample containing the same solution they added pancreatic juice of a person who has just had acute pancreatitis. Both samples were incubated for the same period of time. Explain:

a) which sample will contain higher concentration of digestive products and why;

b) which reaction take place in these samples. Write the patterns of these reactions.

**13.** Write the formula of TAG 1-palmitoyl-2-linolenoyl-3-stearoylglycerol. Pay attention to the fact that such composition of fatty acids is typical of animal fats. Vegetable oils contain more polyunsaturated fatty acids and are liquid. Write the example of formula TAG of a vegetable oil.

**14.** Write the reaction of hydrolysis of TAG 1-linolenoyl-2-palmitoyl-3-oleoylglycerol under the influence of pancreatic lipase.

**15.** A patient has steatorrhea (removal of undigested fats with feces). What are the reasons and consequences of steatorrhea? To answer this question:

a) write the reactions which take place during digestion of fats;

b) make a diagram showing stages of assimilation of edible fats;

b) describe the role of pancrea and bile in the process of fats digestion;

r) enumerate recommendations concerning nutrition which should be given to a patient.

**16.** The boy of 3 years old has a decreased capacity to physical work. Research of muscle biopsy showed that carnitine concentration in tissues is less than the norm by 3 times. Vacuoles of fat were discovered in a cytosol of muscle cells. What are the probable causes of such a condition? To answer this question:

a) write the reactions of metabolic pathways which are disturbed in case of this patient;

b) explain the role of carnitine in this process.

**17.** Calculate the amount of  $\Delta T\Phi$  after oxidation of 1 mole of oleic acid. Prove your answer with calculations with an explanation.

**18.** Long-time diabetes can lead to development of acidosis. What compounds being in increased concentration lead to abnormal changes in pH value of blood? To answer the question:

a) name this compounds;

b) write the metabolic pathway diagrams which increased activity leads to acidosis

**19.** Say, what bonds are decomposed in the peptide under the influence of carboxipeptidase and chymotripsin. Write the given peptide

Gly - Ser - Phe - Thr - Lys - Val

**20.** Say, what bonds are mainly decomposed in the peptide under the influence of chymotripsin and tripsin. Write the given peptide

Asp - Gln - Tyr - Ser - Lys - Leu - Gly

**21.** Write the type of deamination which is possible in case of serine. Write the formula which proves your answer, name the enzyme.

**22.** In case of influenza children may suffer from severe form of hyperammoniemia which is accompanied by vomit, loss of consciousness, convulsions. It is discovered that influenza virus may disturb synthesis of carbamoylphosphatesynthetase I. Which substances increase in blood in case of this situation? Write the chemical equation of the reaction which is catalyzed by carbamoylphosphatesynthetase I

**23.** A child patient had increased concentration of phenylpyruvate in urine (in norm it is practically absent). Concentration of phenylalanine in blood was 35 mg/dL (in norm - nearly 1,5 mg/dL). Which disease can be accompanied by such symptoms? What possible causes of this disease (to do this write the necessary reaction)?

**24.** Urine of a newly born baby darkens if there is its contact with air. Recollect information about enzymopathies of aminoacids metabolism and say, accumulation of what substances leads to this symptom. Metabolism of what aminoacid is disturbed in case of this disease? What is the disease? Write the pattern of the necessary process.

**25.** Albinoes (people with pale skin and white hair) are not tolerant to insolation, suntan on their skin does not appear, instead of this burns appear on their skin. What metabolic disturbances lead to such a phenomenon? Write the reaction, name the enzyme.

**26.** A patient which was admissioned to hospital with complaints on acute pains in small joints. The diagnosis was a gout. The doctor prescribed allopurinol. Explain, why allopurinol relieves this patient's conditions. To do this:

- a) write the pattern of metabolic pathway which speed increases in case of this patient;
- б) explain the mechanism of allopurinol activity;
- в) say, what substance will be the end-product of purine catabolism as a result of treatment by this medication.

**27.** Structural analogue of thimine is 5-fluorouracyl and it has strong cytostatic effect and is often used for chemotherapy of tumors. To explain such effect of 5-fluorouracyl:

- a) write the pattern of the reaction which is inhibited by this drug;
- б) say, synthesis of which nucleic acid is disturbed by this drug and why

**28.** Tourists did not take proper amount of provisions and were starving for 2 days. How did concentration of glucose and fatty acids in blood of tourists change by the end of the 2-nd day of starvation? To answer this question:

- a) say, concentration of which hormones increases in blood as a result of starvation;
- б) describe the mechanism of transmission of signals of these hormones in target-cells;
- в) write the pattern of metabolic pathways which are facilitated by these hormones in liver in case of starvation in liver.

**29.** A patient with diabetes mellitus was prescribed insulin injections, but it lead to no positive effect, and concentration of glucose in blood remained high. Which type of diabetes mellitus can be in case of this patient? To prove your answer:

- а) enumerate type of diabetes mellitus and causes which can lead to such a disease;
- б) explain the cause of hyperglycemia in case of such patients;
- в) write the pattern of metabolic pathway which explains increase in glucose concentration in blood in case of diabetes mellitus.

**30.** A patient suffering from chronical infectious-allergic disease was being prescribed prednisolone (structural analogue of cortisol) for long-time period. After his conditions improved the medications intake was stopped. Soon after that symptoms of hypocorticism appeared (weakness, hypotonia, hypoglycosemia). Concentration of 17-ketosteroids in urine was lower than the norm.

- А. How can you explain the worsening of the patient's conditions?
- Б. Will his conditions improve if he is injected corticotropin?

**31.** A child which has adequate nutrition and consumes vitamin D<sub>3</sub> suffers from indications of rachitis. Concentration of calcium in blood is at the lower limit of the norm. What are the possible reasons for rachitis in this case? Explain your answer. To do this:

- а) name possible causes of rachitis;
- б) name hormones regulating exchange of calcium ions in the organism, enumerate their biological effects;
- в) write the pattern of synthesis of the hormone to prove possible cause of rachitis.

**32.** After a patient's examination it was discovered that he suffers from hypertension and decreased concentration of potassium in blood. Activity of renin

was decreased, concentration of aldosterone in blood plasma was above the norm. Computer tomography showed that there is a swelling of the left adrenal gland. Can it be recommended to this patient to intake drugs which are inhibitors of angiotensine transforming enzyme for treatment of hypertension To answer:

- a) write the diagram showing mechanisms of aldosterone secretion regulation;
- б) explain how will concentration of angiotensine II change during hyperproduction of aldosterone;
- в) name other biochemical indexes of blood which is necessary to test in case of this patient.

**33.** A patient with obvious yellowness of skin, sclerae and mucous coats was admissioned to a hospital. Urine test showed that there was direct bilirubin and urobilin in urine. The color of urine resembled the color of dark beer. Which blood test should be done and which results could be seen basing on the given information? To answer the question:

- a) write the pattern of bilirubin production;
- б) describe further bilirubin transformations into end-products of decomposition which are excreted from the organism.

**34.** People who consume alcohol for a long time are less affected by some medications and narcotic substances during surgical interference. Why there is tendency to biotransformation of medicinal drugs in case of such people? To answer:

- a) write reactions of ethanol catabolism in liver;
- б) explain, how ethanol affects microsomal oxidation in liver.

**35.** A newly-born baby has increased concentration of indirect bilirubin in blood, fucus is brightly colored (increased concentration of urobilin). Bilirubin in urine is not detected. Which type of jaundice is in case of this baby? To give an answer:

- a) write the pattern of bilirubin production;
- б) name medicinal drug which can be used for prevention of this disease and explain the mechanism of its activity.

**36.** The king Mitridat (Crimean Kingdom) was systematically consuming small doses of natural poisons in order not to suffer from acute poisoning. What is so called "Mitridat effect" based on? To answer this:

- a) write the pattern of toxic substances deactivation, name enzymes and coenzymes;
- б) why did systematic intake of small doses of natural poisons helped the king to avoid acute intoxication.

**37.** Medicational drug called «Desulfiram» is used to treat chronical alcoholism, its usage leads to accumulation of acetic aldehyde in human organism. Which enzyme is inhibited during treatment with "Disulfiram"? Explain your answer by writing structural formula of the chemical reaction.

**38.** If there is genetic defect of the key enzyme of hydrolysis which is pyruvatekinase patients have hemolysis of erythrocytes. Why is the metabolic pathway with participation of pyruvatekinase important for erythrocytes? To answer this question:

- a) write the pattern of metabolic pathway where pyruvatekinase participates;

6) explain why hemolysis of erythrocytes gets accelerated.

**39.** If there are no ions of  $\text{Ca}^{2+}$  blood does not coagulate. What is the role of  $\text{Ca}^{2+}$  in coagulation of blood? To answer the question:

a) describe composition of membrane complexes of procoagulation pathway of blood clotting and sequence of their interaction;

6) what is the role of  $\text{Ca}^{2+}$  in formation of these complexes

**40.** Analgetic and pyretic substance called paracetamol is included into composition of some medicational drugs. Paracetamol accelerates production of active forms of  $\text{O}_2$  in the organism. If there is genetic defect of some enzyme within pentose phosphate pathway, could treatment by such medications lead to hemolytic anemia? To answer:

a) write the reaction of production of superoxide anion in erythrocytes;

6) write the pattern of deactivation of active forms of  $\text{O}_2$  in erythrocytes and explain the role of the enzyme of pentosephosphate pathway in this process.

**41.** Some severe kidney diseases are accompanied by edemas caused by albuminuria. Why does albuminuria lead to edemas? To explain it:

a) write special characteristics of aminoacidic composition of albumin;

6) write functions of albumin.

**42.** Dicumarol which is a structural analogue of vitamin K was used as poison for killing rodents at the beginning of the last century. What is toxic effect of dicumarol based on? To answer this question:

a) explain the role of vitamin K in posttranslational maturation of some enzymes of blood coagulating system;

6) name basic sources of this vitamin

**43.** Hereditary deficiency of protein C may cause venous thrombosis and pulmonary embolism. What is the role of activated protein C in hemostasis? To answer this question:

a) write the pattern of reactions of anticoagulant pathway;

6) explain the role of thrombin in hemostasys.

**44.** Wound repair leads to formation of connective-tissue cicatrices (scars). Within this period there is active synthesis of all the components of intercellular matrix. Which is the basic component of intercellular matrix? To answer this question:

a) name special characteristics of composition and structure of this protein and also name the changes which take place with peptide bond at this stage?

6) what are the basic stages of its synthesis and maturation;

b) which posttranslational transfromation does this protein undergo, which vitamin participates in this process.

**45.** One of the clinical manifestations of scorbute is haemorrhages under skin and mucous coats. Deficiency of which vitamin leads to this diseases? To answer this question:

a) name this vitamin and its basic function in the production of intercellular matrix;

6) write the reaction of hydroxilation of proline and lysine;

b) name the substances which are necessary for this reaction to occur.

**46.**  $\alpha$ -chain of collagen contains many residues of glycine. Mutations which lead to replacement of glycine into another aminoacid lead to serious consequences: bone

fragility, dental abnormalities, hypermobility of joints, etc. Why does it take place? To answer:

- a) say, what aminoacids are included into collagen;
- б) what are special characteristics of the primary structure of collagen and what is its posttranslational modification;
- в) explain, what role does it all have for production of normal molecule of tropocollagen.

**47.** Some forms of porphyria do not manifest themselves until the period of sexual maturation of a person. Why do changes in hormonal status cause exacerbation of the disease? To answer the question, say:

- A. which enzymes of heme synthesis induce sex hormones;
- Б. write regulatory reaction of heme synthesis

**48.** It is known that estrogens provide anabolic effect on bones and cartilages. During menopause women have increased risk of bone fracture. Why does it happen so? To answer this question:

- a) say, synthesis of which primary structural protein of bone tissue is induced by estrogens;
- б) name the mechanism of transfer of a signal to target-cells by estrogens. Prove your answer by a necessary diagram.

**49.** Collagen fibrillae are held together by intra- and interchain covalent linkages. Which aminoacid participates in formation of these linkages? To answer this question:

- a) write the formula of this reaction
- б) name the enzyme which catalyzes this reaction and name all the necessary cofactors

**50.** Diffuse scleroderma is a disease when synthesis of collagen increases, fibrosis of skin and internal organs develops. Which component indicates that there is intensive metabolism of collagen and that there are its changes in case of this disease? To answer this question:

- a) say, what are special characteristics of collagen catabolism, its basic enzyme and product which appears in urine and blood;
- б) say, how these characteristics change if a patient is treated by steroid hormones (you know that such hormones suppress production of procollagen by mRNA).